

A PROPOSED INTERNATIONAL UNIT OF LIGHT

Department of Commerce and Labor

BUREAU OF STANDARDS

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The following announcement, relative to the unit of light of America, France, and Great Britain, is being made simultaneously in these three countries. The announcement is being made in Great Britain by Dr. R. T. Glazebrook, Director of the National Physical Laboratory, and in France by Prof. Paul Janet, Director of the Laboratoire Central d'Électricité.

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In order to determine as accurately as possible the relations between the photometric units of America, France, Germany, and Great Britain, comparisons have been made at different times during the past few years between the unit of light maintained at the Bureau of Standards, Washington; at the Laboratoire Central d'Électricité, Paris; at the Physikalisch-Technische Reichsanstalt, Berlin, and at the National Physical Laboratory, London.

The unit of light at the Bureau of Standards has been maintained through the medium of a series of incandescent electric lamps, the values of which were originally intended to be in agreement with the British unit, being made 100/88 times the Hefner unit.

The unit of light at the Laboratoire Central is the bougie décimale, which is the twentieth part of the standard defined by the International Conference on Units of 1884, and which is taken, in accordance with the experiments of Violle, as 0.104 of the Carcel lamp.

The unit of light at the Physikalisch-Technische Reichsanstalt is that given by the Hefner lamp burning at normal barometric pressure (76 cm) in an atmosphere containing 8.8 liters of water vapor per cubic meter.

The unit of light at the National Physical Laboratory is that given by the 10-candle-power Harcourt pentane lamp burning at normal barometric pressure (76 cm) in an atmosphere containing 8 liters of water vapor per cubic meter.

In addition to the direct intercomparison of flame standards carried out recently by the national laboratories in Europe, one comparison was made in 1906 and two in 1908 between the American and European units by means of carefully seasoned carbon-filament electric standards, and as a result of all the comparisons the following relations are established between the above units:

The pentane unit has the same value within the errors of experiment as the bougie décimale. It is 1.6 per cent less than the standard candle of the United States of America, and 11 per cent greater than the Hefner unit.

In order to come into agreement with Great Britain and France, the Bureau of Standards of America proposed to reduce its standard candle by 1.6 per cent, provided that France and Great Britain would unite with America in maintaining the common value constant, and with the approval of other countries would call it the International candle. The National Physical Laboratory, London, and the Laboratoire Central

d'Électricité, Paris, have agreed to adopt this proposal in respect to the photometric standardization which they undertake, and the date agreed upon for the adoption of the common unit and the change of unit in America is April 1, 1909.

The following simple relations will therefore hold after that date:

1 International Candle = 1 Pentane Candle.

1 International Candle = 1 Bougie Décimale.

1 International Candle = 1 American Candle.

1 International Candle = 1.11 Hefner Unit.

1 International Candle = 0.104 Carcel Unit.

Therefore 1 Hefner Unit = 0.90 International Candle.*

The pentane and other photometric standards in use in America will hereafter be standardized by the Bureau of Standards in terms of the new unit. This, within the limits of experimental error, will bring the photometric units for both gas and electrical industries in America and Great Britain and for the electrical industry in France to a single value, and the Hefner Unit will be in the simple ratio of 9/10 to this international unit.

The proposal to call the common unit of light to be maintained jointly by the national standardizing laboratories of America, France, and Great Britain, the "International candle" has been submitted to the International Electrotechnical Commission, which has undertaken to secure the indorsement of the proposal by all countries of the world which are represented on that Commission.

It is hoped that such general approval will be secured, and that in the near future the term "International Candle" will have official international sanction.

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The above announcement marks an important step forward in the history of photometric measurements. For many years the British parliamentary candle was the unit recognized in this country, but the lack of precision in practical photometry did not permit its value to be very accurately expressed or reproduced. In recent years the gas industry has employed the 1-candlepower sperm candle, the 10-candlepower Harcourt pentane lamp, the Hefner lamp, and various secondary standards, while the electrical industry has employed incandescent electric lamps certified by the Bureau of Standards. The unit of the Bureau has been maintained very constant, as shown by frequent comparisons with the standards of France, Germany, and Great Britain, but differed appreciably from the British unit and hence from the unit employed by most of the gas companies in America.

The Bureau of Standards took the initiative several years ago in bringing about international uniformity in the unit of light by sending its representatives abroad with copies of its standards to determine more accurately the relative values of the units of the several European countries, and to urge the adoption of an international unit. In this country the American Institute of Electrical Engineers, the American Gas Institute, and the Illuminating Engineering Society have acted together in support of the movement, and have voted in advance to recognize the new unit of candlepower.

In England the National Physical Laboratory has secured the indorsement of the London Gas Referees and the Institution of Gas Engineers.

The union of the three national standardizing institutions of America, France, and Great Britain in maintaining a common unit of candlepower, and the cooperation of the German Reichsanstalt in redetermining, from time to time, the ratio of the Hefner unit

to the common international candle, assures the highest attainable constancy for the new unit of light.

Unfortunately there is no primary photometric standard that is sufficiently constant and reproducible to be generally accepted as an international standard. France, Germany, and Great Britain each have their own primary flame standard, and a great deal of effort has been expended in attempting to determine accurately the relations between them. Until the flame standards themselves are better understood, however, and the atmospheric and other conditions more perfectly controlled, the unit of light can not be preserved as accurately by primary flame standards as by incandescent electric secondary standards. The latter, when well made, properly seasoned, and carefully measured, permit comparisons to be made (using the means of many settings on several lamps) with excellent precision, the lamps themselves being constant enough and the precision of measurement high enough to fix the final values to about one or two tenths of 1 per cent. There is good reason to believe that in this way the international unit of light can be preserved so nearly constant that any inevitable drift occurring one way or the other would be too small to detect with certainty by any of our present flame standards in many years. The Bureau of Standards will continue to standardize flame standards by the electric standards and will also carefully investigate the flame standards. Similar tests and investigations will also be made in Europe, and if any appreciable drift does occur it will sooner or later be detected.

The effect of this change of 1.6 per cent in the unit of the Bureau, which is in general use for electric lighting throughout the country, is to raise the candlepower rating and decrease slightly the watts-per-candle of electric lamps. A 16-candlepower lamp will give 16.26 candles in the new unit, or a 16-candlepower carbon filament lamp burning at 110 volts will give 16 candles on the new basis at 109.69 volts. The change, though small, is important in the photometry and rating of lamps.

The new unit of candlepower being in agreement with the present English unit as represented by a 10-candlepower standard pentane lamp, there will be no change in the unit of light now employed by those gas companies which use pentane lamps, provided they are in agreement with the English standard. But as pentane lamps may differ slightly from one another, even when burned under the same conditions, it is desirable to have them standardized in terms of the international candle. These variations, amounting to from 1 to 5 per cent, are generally in the same direction, that is, the lamps if not correct usually give less than 10 international candles under standard conditions when burning in a pure atmosphere at a normal barometric pressure of 76 cm of mercury and an atmospheric humidity of 8 liters of water vapor per cubic meter.

Gas standards will be certified after April 1, 1909, in terms of the international candle. Electric standards will be certified in terms of the old unit until July 1, 1909, unless otherwise requested. After July 1 only the new unit will be recognized by the Bureau of Standards and by the Government in the certification of standards and in the inspection and testing of lamps.

Further information with regard to change of photometric unit or to the testing of gas and electric standards will be given on request.

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Approved:

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